

IN THE CLAIMS:

- 1 1. (Currently Amended): A method for enabling parity declustering in a balanced parity array of a storage system, where an operating system performs the method comprising the steps of:
 - 4 combining a plurality of unbalanced stripe arrays to form the balanced array, each
 - 5 unbalanced stripe array having parity blocks on a set of storage devices that are disjoint
 - 6 from a set of storage devices storing data blocks; and
- 7 distributing assignment of storage devices to parity groups throughout the bal-
- 8 anced array.
- 1 2. (Original): The method of Claim 1 further comprising the step of, after a single or
- 2 double storage device failure, ensuring that all surviving data storage devices are loaded
- 3 uniformly during reconstruction of the failed storage device or devices.
- 1 3. (Original): The method of Claim 1 wherein the storage system is a filer.
- 1 4. (Original): The method of Claim 1 further comprising the steps of:
 - 2 dividing each storage device into blocks; and
 - 3 organizing the blocks into stripes across the devices, wherein each stripe contains
 - 4 data and parity blocks from each of the devices of the balanced array.
- 1 5. (Original): The method of Claim 4 wherein the step of distributing comprises the step
- 2 of selecting patterns of characters representing data storage devices of a stripe to thereby

3 change the association of the data storage devices with parity groups from stripe to stripe
4 of the balanced array.

1 6. (Original): The method of Claim 5 wherein the characters are binary numbers.

1 7. (Original): The method of Claim 5 wherein the characters are ternary numbers.

1 8. (Original): The method of Claim 1 further comprising the steps of:

2 configuring the balanced array as a RAID-4 style array;

3 initially under-populating the array with storage devices; and

4 adding storage devices until a fully populated array of predetermined size is
5 achieved.

1 9. (Original): The method of Claim 8 wherein the storage devices are disks.

1 10. (Original): A system that enables parity declustering in a balanced parity array of a
2 storage system, the system comprising:

3 a plurality of storage devices, each storage device divided into blocks that are fur-
4 ther organized into stripes, wherein each stripe contains data and parity blocks from each
5 of the devices of the balanced array;

6 a storage operating system including a storage layer configured to implement a
7 parity assignment technique that distributes assignment of devices to parity groups
8 throughout the balanced array such that all storage devices contain the same amount of
9 data or parity information; and

10 a processing element configured to execute the operating system to thereby in-
11 voke storage access operations to and from the balanced array in accordance with the
12 concentrated parity technique.

1 11. (Original): The system of Claim 10 wherein the storage layer further combines a
2 plurality of unbalanced stripe arrays to form the balanced array, each unbalanced stripe
3 array having parity blocks on a set of storage devices that are disjoint from a set of stor-
4 age devices storing data blocks.

1 12. (Original): The system of Claim 11 wherein the storage devices are disks and
2 wherein the storage layer is a RAID layer.

1 13. (Original): The system of Claim 12 wherein the RAID layer is implemented in logic
2 circuitry.

1 14. (Original): The system of Claim 10 wherein the storage system is a network-
2 attached storage appliance.

1 15. (Original): The system of Claim 10 wherein the storage devices are one of video
2 tape, optical, DVD, magnetic tape and bubble memory devices.

1 16. (Original): The system of Claim 10 wherein the storage devices are media adapted
2 to store information contained within the data and parity blocks.

1 17. (Original): Apparatus for enabling parity declustering in a balanced parity array of a
2 storage system, the apparatus comprising:

3 means for combining a plurality of unbalanced stripe arrays to form the balanced
4 array, each unbalanced stripe array having parity blocks on a set of storage devices that
5 are disjoint from a set of storage devices storing data blocks; and

6 means for distributing assignment of devices to parity groups throughout the bal-
7 anced array such that all storage devices contain the same amount of data or parity infor-
8 mation.

1 18. (Original): The apparatus of Claim 17 further comprising:

2 means for dividing each storage device into blocks; and

3 means for organizing the blocks into stripes across the devices, wherein each
4 stripe contains data and parity blocks from each of the devices of the balanced array.

1 19. (Original): The apparatus of Claim 18 wherein the means for distributing comprises
2 means for selecting patterns of characters representing data storage devices of a stripe to
3 thereby change the association of the data storage devices with parity groups from stripe
4 to stripe of the balanced array.

1 20. (Original): A computer readable medium containing executable program instructions
2 for enabling parity declustering in a balanced parity array of a storage system, the execu-
3 table program instructions comprising program instructions for:

4 combining a plurality of unbalanced stripe arrays to form the balanced array, each
5 unbalanced stripe array having parity blocks on a set of storage devices that are disjoint
6 from a set of storage devices storing data blocks; and

7 distributing assignment of devices to parity groups throughout the balanced array
8 such that all storage devices contain the same amount of data or parity information.

1 21. (Original): The computer readable medium of Claim 20 further comprising program
2 instructions for:

3 dividing each storage device into blocks; and
4 organizing the blocks into stripes across the devices, wherein each stripe contains
5 data and parity blocks from each of the devices of the balanced array.

1 22. (Original): The computer readable medium of Claim 21 wherein the program in-
2 structions for distributing comprises program instructions for selecting patterns of charac-
3 ters representing data storage devices of a stripe to thereby change the association of the
4 data storage devices with parity groups from stripe to stripe of the balanced array.

1 23. –37. (Cancelled)

1 38. (Currently Amended) A method for declustering a parity array having a plurality of
2 storage devices, where an operating system performs the method comprising the steps of:

3 assigning a first plurality of data and parity blocks to a first parity group; and
4 assigning a second plurality of data and parity blocks to a second parity group, the
5 first and second parity groups being independent from each other and distributed
6 throughout the plurality of storage devices of the parity array.

1 39. (Cancelled)

1 40. (Currently Amended) A method for declustering a parity array having a plurality of
2 storage devices, where an operating system performs the method comprising the step of:

3 assigning a plurality of data and parity blocks to a plurality of parity groups, the
4 plurality of parity groups being independent from each other and distributed throughout
5 the plurality of storage devices of the parity array.

1 41. (Currently Amended) A disk array having a declustered parity array, comprising:

2 a plurality of storage devices having a first and second parity group;
3 a first plurality of data and parity blocks assigned to the first parity group; and
4 a second plurality of data and parity blocks assigned to the second parity group,
5 the first and second parity groups being independent from each other and distributed
6 throughout the plurality of storage devices of the parity array.

1 42. (Cancelled)

1 43. (Currently Amended) A disk array having a declustered parity array, comprising:

2 a plurality of storage devices having a plurality of parity groups; and
3 a plurality of data and parity blocks assigned to the plurality of parity groups, the
4 plurality of parity groups being independent from each other and distributed throughout
5 the plurality of storage devices of the parity array.

1 44. (Currently Amended) A disk array having a declustered parity array, comprising:

2 a plurality of storage devices;

3 means for assigning a first plurality of data and parity blocks to a first parity
4 group; and

5 means for assigning a second plurality of data and parity blocks to a second parity
6 group, the first and second parity groups being independent from each other and distrib-
7 uted throughout the plurality of storage devices of the parity array.

1 45. (Cancelled)

1 46. (Currently Amended) A disk array having a declustered parity array, comprising:
2 a plurality of storage devices; and

3 means for assigning a plurality of data and parity blocks to a plurality of parity
4 groups, the plurality of parity groups being independent from each other and distributed
5 throughout the plurality of storage devices of the parity array.

1 47. – 54. (Cancelled)